

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES**

In Re Application of:

Mukai et al.

Application No.: 09/910,583

Filed: July 20, 2001

For: METHOD AND APPARATUS FOR
CONTROLLING DOPANT
CONCENTRATION DURING BPSG FILM
DEPOSITION TO REDUCE NITRIDE
CONSUMPTION

Examiner: David P. Turocy

Art Unit: 1762

Confirmation No: 1386

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Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

APPEAL BRIEF UNDER 37 C.F.R. § 41.37(a)

This is an appeal to the Board of Patent Appeals and Interferences from the decision of the Examiner of Group 1386, dated August 2, 2007, which finally rejected Claims 14-17 in the above-identified application. The Office's date of receipt of Appellant's Notice of Appeal was November 1, 2007. This Appeal Brief is hereby submitted pursuant to 37 C.F.R. § 41.37(a).

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I. REAL PARTY IN INTEREST

The real party in interest and assignee of record is Applied Materials, Inc., a corporation of Delaware having a principle place of business at 3050 Bowers Avenue, Santa Clara, California 95054.

II. RELATED APPEALS AND INTERFERENCES

To the best of Appellant's knowledge, there are no appeals or interferences related to the present appeal that will directly affect, be directly affected by, or have a bearing on the Board's decision in the instant appeal.

III. STATUS OF THE CLAIMS

Claims 14-19 and 23 are pending in the present application.

Claims 1-13, 20-22 and 24-32 have been canceled.

Claims 18, 19 and 23 have been allowed.

Claims 14-17 have been finally rejected under 35 U.S.C. 103(a) in an Office Action mailed August 2, 2007.

Claims 14-17 are the subject of this appeal. A copy of Claims 14-17 as they stand on appeal are set forth in Appendix A.

IV. STATUS OF AMENDMENTS

No amendments have been submitted subsequent to the Final Office Action mailed August 2, 2007.

V. SUMMARY OF CLAIMED SUBJECT MATTER

This section of this Appeal Brief is set forth to comply with the requirements of 37 C.F.R. 41.37(c)(1)(v) and is not intended to limit the scope of the claims in any way. Exemplary implementations of the limitations of independent claim 14 and dependent claims 15-17 are described below.

Appellant's invention, as claimed in claims 14-17, is directed to a method of forming an insulating film on a substrate to reduce nitride consumption during manufacture.

The method comprises placing a substrate having a nitride layer thereon in a reaction chamber (*see, e.g.*, Fig. 5 operation 502 and paragraphs [0017] and [0049]). A silicon source gas, an oxygen source gas, a boron source gas and a phosphorous source gas are then provided for chemical vapor depositing a doped silicate glass layer over the nitride layer (*see, e.g.*, paragraphs [0017] and [0050]). Prior to mixing, in the reaction chamber, any of the flows of the silicon, oxygen, boron or phosphorous source gases, the flows are individually stabilized (*see, e.g.*, Fig. 5 operation 503 and paragraphs [0017] and [0050]). The silicon source gas, the oxygen source gas and the boron source gas are then injected into the chamber for a predetermined period of time to form a borosilicate glass layer over the nitride layer on the substrate (*see, e.g.*, Fig. 5 operation 504 and paragraphs [0018] and [0051]). Finally, the phosphorous source gas is injected into the chamber while injection of the silicon, oxygen and boron source gases into the chamber is continued in order to deposit a borophosphosilicate glass layer over the borosilicate glass layer (*see, e.g.*, Fig. 5 operation 506 and paragraphs [0018] and [0052]). That is, **Appellant teaches and claims a**

method including individually stabilizing the flows of the silicon, oxygen, boron and phosphorous source gases prior to mixing any of these flows.

In dependent claim 15, the predetermined period of time to deposit a borosilicate glass layer over the nitride layer is in a range of approximately 3-30 seconds (*see, e.g.*, paragraph [0051]).

In dependent claim 16, the predetermined period of time to deposit a borosilicate glass layer over the nitride layer is about 10 seconds (*see, e.g.*, paragraph [0051]).

In dependent claim 17, the method further comprises annealing the borophosphosilicate glass layer at a temperature in a range of approximately 750 °C to 1050 °C in an ambient selected from the group consisting of steam ambient, water ambient and ambient formed by in-situ reaction of H₂ and O₂ (*see, e.g.*, Fig. 5 operation 508 and paragraphs [0018] and [0053]).

VI. GROUNDS OF REJECTIONS TO BE REVIEWED ON APPEAL

Whether claims 14-17 are unpatentable under 35 U.S.C. 103(a) over Yang (KR 2001055915), hereinafter "Yang," in view of Xia et al. (EP 0843348), hereinafter "Xia," and further in view of Germann et al. (EP 1139403), hereinafter "Germann."

VII. ARGUMENT

Claim Rejections – 35 U.S.C. § 103(a)

Claims 14-17

Claims 14-17 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Yang in view of Xia, and further in view of Germann. The Examiner relies on Yang to disclose depositing a borosilicate glass film and then depositing a film of borophosphosilicate glass on the borosilicate glass layer (Office Action dated April 24, 2007; page 5, second paragraph; incorporated by reference in the Final Office Action mailed August 2, 2007). The Examiner relies on Xia to disclose using silicon, oxygen, and boron source gases to form a borosilicate glass layer and using silicon, oxygen, boron and phosphorous source gases to form a borophosphosilicate glass layer (Office Action dated April 24, 2007; page 5, second paragraph; incorporated by reference in the Final Office Action mailed August 2, 2007). However, the Examiner states on page 7 of the Office Action dated April 24, 2007 (incorporated by reference in the Final Office Action mailed August 2, 2007) that the combination of Yang and Xia “does not explicitly disclose delaying introduction of the source gases into the chamber until their flows stabilize.” Instead, the Examiner relies on Germann to disclose delaying introduction of the source gases into the chamber until their flows stabilize. In relying on Germann, however, the Examiner states on page 2 of the Final Office Action mailed August 2, 2007 that

“While [Germann] may disclose stabilizing the gas mixture ratio, such a disclosure suggests that the gases are individually stabilized. To stabilize the ratio of the gases in a mixture, each of the gases in the mixture must each individually be stable. If one of the gases in a mixture is not stable then the entire mixture will not

be stable. Therefore, by stabilizing a gas comprising all components, then each gas is individually stabilized.”

Claim 14 includes the element “**stabilizing individually**” the flows of source gases “**prior to mixing any of the flows**.” Claim 14 recites:

A method of forming an insulating film on a substrate to reduce nitride consumption during manufacture, the method comprising:
placing a substrate having a nitride layer thereon in a reaction chamber;
providing a silicon source, an oxygen source, a boron source and a phosphorous source for chemical vapor depositing a doped silicate glass layer over the nitride layer; and
prior to mixing any of the flows of the silicon, oxygen, boron or phosphorous sources, **stabilizing individually the flows** of the silicon, oxygen, boron and phosphorous sources;
injecting the silicon source, the oxygen source and the boron source into the chamber for a predetermined period of time to form a borosilicate glass layer over the nitride layer on the substrate; and
injecting the phosphorous source into the chamber while continuing injecting the silicon, oxygen and boron sources into the chamber to deposit a borophosphosilicate glass layer over the borosilicate glass layer.

“The legal concept of *prima facie* obviousness is a procedural tool of examination which applies broadly to all arts.” M.P.E.P. § 2142. The ultimate determination of patentability is based on the entire record, by a **preponderance of evidence**, with due consideration to the persuasiveness of any arguments and any secondary evidence. *In re Oetiker*, 977 F.2d 1443, 24 USPQ2d 1443 (Fed. Cir. 1992). The legal standard of “a preponderance of evidence” requires the evidence to be more convincing than the evidence which is offered in opposition to it.” Manual of Patent Examining Procedure (M.P.E.P.) § 2142.

Appellant respectfully submits that the Examiner has not shown that claims 14-17 are obvious by a preponderance of the evidence. Appellant

respectfully submits that claims 14-17 are patentable over the cited references because **the combination of references fails to teach each and every element** of independent claim 14.

The prior art fails to disclose “stabilizing individually” the flows of source gases “prior to mixing any of the flows” as taught and claimed by Appellant

The Examiner relies on Germann to disclose “delaying introduction of source gases into a chamber until their flows stabilize” (Office Action dated April 24, 2007; page 8, final paragraph; incorporated by reference in the Final Office Action mailed August 2, 2007). Indeed, Germann does disclose bypassing a reactor with a mixture of gases until the mixture of gases stabilizes (see abstract, paragraph [0009]). However, Germann fails to disclose a method including individually stabilizing source gas flows prior to mixing the source gas flows, as taught and claimed by Appellant. That is, the source gas flows of Germann are stabilized as a mixture rather than individually. Thus, **Germann discloses stabilizing a mixture of source gas flows**, whereas **Appellant teaches and claims individually stabilizing each source gas flow prior to mixing the source gas flows**.

The Examiner argues that if the gas mixture of Germann is stabilized, then each of the individual gases of the mixture must necessarily be stabilized (Office Action dated April 24, 2007; page 8, final paragraph; incorporated by reference in the Final Office Action mailed August 2, 2007). However, Appellant points out that it is well known in the art that a mixture of gases does not necessarily exhibit the combined properties of each individual gas. Thus, the conditions required to

stabilize a gas mixture are typically not the same as the conditions required to stabilize each individual gas. That is, merely because a mixture of gases is stabilized, it does not mean that the individual gases would otherwise be stabilized under the same conditions.

Furthermore, in claims 14-17, the introduction of the phosphorous source gas is delayed while the other source gases are introduced into a reaction chamber to form a borosilicate glass layer. The phosphorous source gas is then introduced into the chamber, following a predetermined amount of time, to form a borophosphosilicate glass layer over the borosilicate glass layer. Accordingly, as taught and claimed by Appellant, the phosphorous source gas requires stabilization individually and not as a component of a mixture, as disclosed in Germann.

As pointed out above, the Examiner merely relies on Yang to disclose depositing a borosilicate glass film and then depositing a film of borophosphosilicate glass on the borosilicate glass layer. As also pointed out above, the Examiner merely relies on Xia to disclose using silicon, oxygen, and boron source gases to form a borosilicate glass layer and using silicon, oxygen, boron and phosphorous source gases to form a borophosphosilicate glass layer. Thus none of Germann, Yang nor Xia, alone or in combination, disclose a method comprising individually stabilizing the flows of the silicon, oxygen, boron and phosphorous source gases prior to mixing, as taught and claimed by Appellant.

In an alternative argument, the Examiner also states on page 2 of the Final Office Action mailed August 2, 2007 that "At the very least, to stabilize the

ratio of a mixture, it would have been obvious to one skilled in the art to stabilize each gas flow individually prior to mixing to achieve the desired result of stabilizing the ratio of gases.” However, the Examiner provides no evidence to support this argument.

Accordingly, Appellant respectfully submits that claims 14-17 are patentable over the cited references because the combination does not teach all of the elements of the claims.

VIII. CONCLUSION

For the reasons stated above, claims 14-17 are patentable under 35 U.S.C. 103(a) over Yang in view of Xia, and further in view of Germann.

Appellant respectfully requests that the Board reverse the rejections of claims 14-17 under U.S.C. § 103(a) and direct the Examiner to enter a Notice of Allowance for claims 14-17.

Fee For Filing A Brief In Support Of Appeal

Enclosed is a check in the amount of \$510.00 to cover the fee for filing a brief in support of an appeal as required under 37 C.F.R. 1.17(c) and 40.20(b)(2). (If a check is not enclosed, you are hereby authorized to charge the deposit account below).

Deposit Account Authorization

Authorization is hereby given to charge our Deposit Account No. 02-2666 for any charges that may be due. Furthermore, if an extension is required, then Appellant hereby requests such extension.

Respectfully submitted,

BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN LLP

Date: January 31, 2008

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APPENDIX A : CLAIMS

Listing of Claims:

1. – 13. (canceled)

14. (previously presented) A method of forming an insulating film on a substrate to reduce nitride consumption during manufacture, the method comprising:

placing a substrate having a nitride layer thereon in a reaction chamber;

providing a silicon source, an oxygen source, a boron source and a

phosphorous source for chemical vapor depositing a doped silicate glass layer over the nitride layer; and

prior to mixing any of the flows of the silicon, oxygen, boron or phosphorous sources, stabilizing individually the flows of the silicon, oxygen, boron and phosphorous sources;

injecting the silicon source, the oxygen source and the boron source into the chamber for a predetermined period of time to form a borosilicate glass layer over the nitride layer on the substrate; and

injecting the phosphorous source into the chamber while continuing injecting the silicon, oxygen and boron sources into the chamber to deposit a borophosphosilicate glass layer over the borosilicate glass layer.

15. (original) The method of claim 14, wherein the predetermined period of time to deposit a borosilicate glass layer over the nitride layer is in a range of approximately 3-30 seconds.

16. (original) The method of claim 14, wherein the predetermined period of time to deposit a borosilicate glass layer over the nitride layer is about 10 seconds.

17. (original) The method of claim 14 further comprising annealing the borophosphosilicate glass layer at a temperature in a range of approximately 750 °C to 1050 °C in an ambient selected from the group consisting of steam ambient, water ambient and ambient formed by in-situ reaction of H₂ and O₂.

18. (previously presented) A method to control nitride consumption during integrated circuit manufacture, the method comprising:

- placing a substrate having a nitride layer in a reaction chamber;
- providing a silicon source, an oxygen source, a boron source and a phosphorous source;

- injecting the silicon, oxygen and boron sources into the reaction chamber while delaying injecting the phosphorous source in the reaction chamber for a predetermined period of time to deposit a boron-rich silicate glass film over the nitride layer;

- injecting a predetermined amount of the phosphorous source in the reaction chamber following the predetermined period of time while continuing injecting the silicon, oxygen and boron sources into the reaction chamber to deposit a borophosphosilicate film over the boron-rich silicate glass film, wherein the borophosphosilicate glass layer comprises approximately 2-9 weight percent of phosphorous; and

annealing the borophosphosilicate glass layer to consume at least a portion of the nitride layer, wherein the predetermined period of time for delaying injecting the phosphorous source and the predetermined amount of the phosphorous source are selected relative to the desired nitride layer consumption.

19. (original) The method of claim 18, wherein the predetermined period of time to deposit a boron-rich silicate glass film over the nitride layer is in a range of approximately 3-30 seconds.

20. – 22. (canceled)

23. (previously presented) The method of claim 18 wherein the desired nitride layer consumption is in the range of 15 – 20 Angstroms of the nitride layer.

24. – 32. (canceled)

APPENDIX B: EVIDENCE

NONE

APPENDIX C: RELATED PROCEEDINGS

NONE